# PATENT ABSTRACTS OF JAPAN

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## (54) COPPER ALLOY SHEET EXCELLENT IN BENDABILITY

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a copper alloy sheet having excellent bendability while keeping the high strength of a Cu-Ni-Si alloy.

SOLUTION: This copper alloy sheet has a composition consisting of, by weight, 0.4-5% Ni, 0.1-1% Si, and the balance Cu with inevitable impurities and containing, if necessary, either or both of 0.01-10% Zn and 0.01-5% Sn. Further, when I{200}, I{311}, and I{220} represent the X-ray diffraction intensities from the {200} plane, {311} plane, and {220) plane at the sheet surface, respectively, inequality [I{200}+I{311}]/I{220}≥0.5 is satisfied.

LEGAL STATUS

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decision of rejection]

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CLAIMS

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[Claim(s)]
[Claim 1] nickel: The copper alloy board excellent in the bending nature characterized by filling the following formula when it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [ the X diffraction intensity from Si:{200} in board front face side ] to I {220} for the X diffraction intensity from I {200} and {311} sides 0.4 - 5wt% including 0.1 - 1wt%.
[I{200}+I{311}]/I{220} >=0.5. [Claim 2] Zn:0.01 - 10wt% is included Si:0.1 - 1wt% nickel:0.4 - 5wt%. When it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [ the X diffraction intensity from the {200} sides in a board front face ] to I {220} for the X diffraction intensity from I {200} and {311} sides, The copper alloy board excellent in the bending nature characterized by filling the following formula.
[I{200}+I{311}]/I{220} >=0.5. [Claim 3] Sn:0.01 - 5wt% is included Si:0.1 - 1wt% nickel:0.4 - 5wt%. When it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [ the X diffraction intensity from the {200} sides in a board front face ] to I {220} for the X diffraction intensity from I {200} and {311} sides, The copper alloy board excellent in the bending nature characterized by filling the following formula.
[I{200}+I{311}]/I{220} >=0.5. [Claim 4] nickel: 0.4 - 5wt% and Si:0.1 - 1wt% and Zn:0.01 - 10wt%, It consists of the remainder Cu and an unescapable impurity including Sn:0.01 - 5wt%. The copper alloy board excellent in the bending nature characterized by filling the following formula when X diffraction intensity from I {311} and {220} sides is furthermore set [ the X diffraction intensity from the {200} sides in a board front face ] to I {220} for the X diffraction intensity from I {200} and {311} sides.
[I{200}+I{311}]/I{220} >=0.5. [Claim 5] B, C, P, S, calcium, V, Ga, germanium, Nb, Mo, Hf, Ta, Each element [ of Bi and Pb ] 0.0001 - 0.1wt%, Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, one sort or two sorts or more of elements chosen from from while of each element [ of Au ] 0.001 - 1wt% -- the sum total -- less than [ 1wt% ] -- the copper alloy board excellent in the bending nature indicated by either of the claims 1-4 characterized by containing

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[Translation done.]

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the copper alloy board excellent in suitable bending nature to use for electronic parts, such as a copper alloy board especially a leadframe, a terminal, a connector, a switch, and a relay.
[0002]
[Description of the Prior Art] Various copper and the copper alloy are used for various electronic parts. In recent years, the flow of small-and-light-izing of electronic parts is progressing quickly. In connection with it, the outstanding bending nature which is equal to adhesion bending or 90-degree bending after notching is being required more often not to mention high intensity and high conductivity by the copper alloy board used for a leadframe, a terminal, a connector, a switch, a relay, etc. The Cu-nickel-Si system alloy is widely used for these uses especially as an alloy which has high intensity, high thermal resistance, a stress relaxation characteristic-proof [ high ], and comparatively high conductivity. However, coexistence of high intensity and bending nature was difficult for the present condition.
[0003]
[Problem(s) to be Solved by the Invention] Conventionally, the elongation in a tension test has been used as the standard as an index of bending nature. Depending for the value of the elongation to the rate of cold working after annealing strongly is known. That is, in order to raise bending nature, it was a stock-in-trade that intensity reduces the rate of cold working low on the assumption that a bird clapper. That is, it was difficult to have made high intensity and the outstanding bending nature combine. this invention was made in view of the above-mentioned technical problem of the conventional material, and aims at obtaining a copper alloy board with the bending nature which was excellent while holding the high intensity of an Cu-nickel-Si system alloy.
[0004]
[Means for Solving the Problem] In order to solve the aforementioned technical problem, as a result of inquiring wholeheartedly about an Cu-nickel-Si system alloy board, by controlling the degree of integration of crystal orientation, this invention person finds out that bending nature can be improved, and came to make this invention. Namely, the copper alloy board concerning this invention contains Si:0.1 - 1wt% nickel:0.4 - 5wt%. When it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [ the X diffraction intensity from the {200} sides in a board front face ] to I {220} for the X diffraction intensity from I {200} and {311} sides, it is characterized by filling the following formula.
[I{200}+I{311}]/I{220} >=0.5. [0005] In addition, the above-mentioned copper alloy board can contain Sn:0.01 - 5wt% either or both sides Zn:0.01 - 10wt%. The above-mentioned copper alloy board Furthermore, B, C, P, S, calcium, V, Ga, germanium, Each element [ of Nb, Mo, Hf, Ta, Bi, and Pb ] 0.0001 - 0.1wt% (when two or more sorts add, it is less than [ 0.1wt% ] in total), one sort or two sorts or more of elements chosen from from while of each element [ of Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, and Au ] 0.001 - 1wt% -- the sum total -- less than [ 1wt% ] -- it can contain
[0006]
[Embodiments of the Invention] Next, the reasons for limitation of the component of the copper alloy concerning this invention, crystal orientation, etc. are explained.
(nickel and Si) These components are effective in raising intensity by forming the intermetallic compound of nickel and Si in the state where it lived together, without reducing conductivity sharply. If less than [ 0.4wt% ] or/, and Si do not have [ nickel ] the effect less than [ 0.1wt% ], and nickel exceeds 5wt(s)% or/and Si exceed 1wt%, hot-working nature will fall remarkably. Therefore, both components are made into Si:0.1 - 1wt% nickel:0.4 - 5wt%.

[0007] (Zn) Although Zn has the operation which raises solder heatproof detachability and migration-proof nature, less than [ 0.01wt% ] is not enough as the effect. If 10wt(s)% is exceeded, while not only conductivity falls, but soldering nature will fall, stress corrosion crack sensitivity-proof becomes high and is not desirable, either. Therefore, Zn may be 0.01 - 10wt%.
(Sn) Sn is a component which raises intensity by solid solution strengthening. 0. If the effect exceeds 5wt% rather than is enough, while the effect will be saturated with less than [ 01wt% ], between heat and cold-working nature deteriorate. Therefore, Sn may be 0.01 - 5wt%.
[0008] (Accessory constituent) Each element of B, C, P, S, calcium, V, Ga, germanium, Nb, Mo, Hf, Ta, Bi, and Pb has the role which raises press blanking nature. Less than [ 0.0001wt% ], the effect does not exist, and if 0.1wt% is exceeded, while hot-working nature will deteriorate, as for these elements, bending nature also deteriorates. Moreover, each element of Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, and Au has the role which raises press blanking nature, and, in addition, raises intensity further by coexistence with an nickel-Si compound. Less than [ 0.001wt% ], the effect does not exist, and if 1wt% is exceeded, while between heat and cold-working nature will deteriorate, as for these elements, bending nature also deteriorates. Therefore, about above-mentioned Be-Au, it considers [ B-Pb / above-mentioned ] as each element 0.001 - 1wt% each element 0.0001 - 0.1wt% (in the case / Two or more sorts add. / the sum total 0.1wt(s)% less than), and it is both the sum total and may be less than / 1wt% /.
[0009] (Crystal orientation) {200} on the front face of a board and the accumulation rate of {311} sides increase, and if the copper alloy board containing nickel and Si is rolled out, its accumulation rate of {220} sides will increase, as it recrystallizes and the particle size becomes large. Although the copper alloy board concerning this invention is finished further hot rolling, cold rolling, solution treatment, cold rolling, deposit annealing, and if needed, and it is distorted and it is manufactured at cold rolling and the process of annealing, it can control this accumulation rate by adjusting the cold rolling process (working ratio) of solution treatment (solution-ized temperature, time) and after that in this manufacturing process. The accumulating-totals working ratio after the temperature to which solution treatment temperature specifically exceeds 710 degrees C, and solution treatment is the conditions that less than 50% is desirable. In addition, it deposit-anneals, or is distorted, and after that takes this accumulation rate, and it does not change a lot depending on annealing. Moreover, the content of nickel and Si also influences an accumulation rate. In this invention, these accumulation rates have bending nature and strong correlation, and the range of a proper accumulation rate is searched for as shown in the aforementioned formula based on knowledge that bending nature is controllable by controlling these accumulation rates on the front face of a board. In addition, if this value becomes not much large also with regards to the intensity of a board as for the value of [I{200}+I{311}]/I {220}, since the intensity of a board will fall, as for this value, 1.0 or less are desirable.
[0010]
[Example] Next, the example of this invention is explained below with the example of comparison. The air dissolution was carried out under charcoal covering in the kryptol furnace, the copper alloy of the chemical composition shown in Table 1 was cast to the book mold, and the 50x80x200mm ingot was produced. This ingot was heated at 930 degrees C, and after hot rolling, water quenching was carried out immediately and it considered as hot-rolling material with a thickness of 15mm. In order to remove the scale of the front face of this hot-rolling material, the front face was cut by the grinder. After cold-rolling this, solution treatment for 20 seconds and 30% of cold rolling were performed at 750 degrees C, it adjusted to 0.25mm of board thickness, deposit annealing of 2 hours was given at 480 degrees C, and the examination was presented.
[0011]
[Table 1]

| | | Cu | Ni | Si | Zn | Sn | 副成分 |
|---|---|---|---|---|---|---|---|
| 発明例 | 1 | 残部 | 0.5 | 0.1 | – | – | |
| | 2 | 残部 | 1.0 | 0.2 | – | – | |
| | 3 | 残部 | 1.8 | 0.4 | – | – | |
| | 4 | 残部 | 3.2 | 0.7 | – | – | |
| | 5 | 残部 | 4.6 | 1.0 | – | – | |
| | 6 | 残部 | 1.8 | 0.4 | 1.1 | – | |
| | 7 | 残部 | 1.8 | 0.4 | – | 0.5 | |
| | 8 | 残部 | 1.8 | 0.4 | 1.1 | 0.5 | |
| | 9 | 残部 | 1.8 | 0.4 | – | – | B:0.01, C:0.001, Be:0.02 |
| | 10 | 残部 | 1.8 | 0.4 | – | – | P:0.005, Mg:0.04, Al:0.1 |
| | 11 | 残部 | 1.8 | 0.4 | – | – | S:0.005, Ca:0.001, Ti:0.05 |
| | 12 | 残部 | 1.8 | 0.4 | – | – | V:0.001, Cr:0.2, Mn:0.04 |
| | 13 | 残部 | 1.8 | 0.4 | – | – | Ga:0.03, Ge:0.02, Fe:0.06 |
| | 14 | 残部 | 1.8 | 0.4 | – | – | Nb:0.01, Co:0.1, Zr:0.07 |
| | 15 | 残部 | 1.8 | 0.4 | – | – | Mo:0.003, Hf:0.008, Ag:0.1 |
| | 16 | 残部 | 1.8 | 0.4 | – | – | Ta:0.004, Cd:0.1, In:0.2 |
| | 17 | 残部 | 1.8 | 0.4 | – | – | Bi:0.0009, Pb:0.008 Sb:0.005 |
| | 18 | 残部 | 1.8 | 0.4 | – | – | Te:0.01, Au:0.07 |
| 比較例 | 19 | 残部 | 0.3 * | 0.07* | – | – | |
| | 20 | 残部 | 5.2 * | 1.2 * | – | – | |
| | 21 | 残部 | 1.8 | 0.4 | 12 * | – | |
| | 22 | 残部 | 1.8 | 0.4 | – | 5.8 * | |
| | 23 | 残部 | 1.8 | 0.4 | – | – | P:0.2* , Mn:0.02 |
| | 24 | 残部 | 1.8 | 0.4 | – | – | Ca:0.002, Fe:1.6* |

*本発明の規定範囲から外れる箇所

[0012] Moreover, in order to obtain the copper alloy board of various crystal orientation accumulation rates in addition to the above-mentioned process, about the alloy of composition of No.3, solution treatment temperature was manufactured to 750-degree C others on conditions (650 degrees C (No.3-5) and 700 degrees C (No.3-2)). Moreover, the rate of cold working after solution treatment was also manufactured to everything but 30% on 50% (No.3-3) and 60% (No.3-6) of conditions. Furthermore, the rate of finishing cold working after deposit annealing was also manufactured to everything [ above ] but 0% on 20% (No.3-4) and 50% (No.3-7) of conditions. About the material (No.3-4, No.3-7) which performed finish cold working after deposit annealing, it annealed by distorting 20 seconds at 450 degrees C. Any conditions adjusted the last board thickness to 0.25mm.

[0013] About these test specimens, tensile strength, proof stress, conductivity, W-bending processability, and crystal orientation were investigated in the following way. The result is shown in Table 2 and 3.

<Tensile strength, proof stress> JIS Z It applied to the method given in 2241 correspondingly. In addition, proof stress adopted 0.2% of permanent sets by the offset method. A test piece is JIS. Z The No. 5 test piece of 2201 was used.

<Conductivity> JIS H It applied to the method given in 0505 correspondingly. Measurement of electric resistance used the double bridge.

<W-bending> JIS H It applied to the method given in 3110 correspondingly. Test piece width of face was set to 10mm, and it bent, having applied the load of 1,000kgf. the ratio of minimum bend-radius R which makes the test piece extraction direction G.W. (a bending shaft is right-angled to a rolling direction), and B.W. (a bending shaft is parallel to a rolling direction), and a crack does not generate, and the test-specimen board thickness t -- R/t estimated

The copper alloy board front face of a <crystal orientation> final-product state (0.25mm thickness) was made to carry out incidence of the X-ray, and the intensity from each diffraction side was measured. Although the measurement depth from a front face changes with incident angles, the crystal orientation data in about 20-30-micrometer Fukashi are obtained at the maximum. Bending nature and correlation compared the rate of the diffraction intensity of {200}, {311}, and {220} sides from the inside, and it asked for the crystal orientation index ([I{200}+I {311}] /I {220}). [ strong ] In addition, the conditions of X-ray irradiation are kind:Cu of an X-ray. K-alpha 1, tube-voltage:40kV, the tube electric current: It was 200mA, and it measured, making a sample rotate within a flat surface.

[0014]

[Table 2]

| | No. | 引張強さ (N/mm²) | 耐力 (N/mm²) | 導電率 (%ISCA) | W曲げ性(R/t) G.W. | W曲げ性(R/t) B.W | 結晶方位指数 ※ | 備考 |
|---|---|---|---|---|---|---|---|---|
| 発明例 | 1 | 500 | 450 | 53 | 0 | 0 | 0.93 | |
| | 2 | 550 | 500 | 52 | 0 | 0 | 0.86 | |
| | 3-1 | 640 | 580 | 50 | 0 | 0 | 0.75 | |
| | 3-2 | 610 | 550 | 51 | 0.5 | 0.5 | 0.59 | (1) |
| | 3-3 | 630 | 570 | 51 | 0.5 | 0.5 | 0.61 | (2) |
| | 3-4 | 660 | 630 | 49 | 1.0 | 1.0 | 0.54 | (3) |
| | 4 | 700 | 640 | 48 | 0.5 | 0.5 | 0.57 | |
| | 5 | 730 | 670 | 46 | 1.0 | 1.0 | 0.51 | |
| | 6 | 640 | 580 | 50 | 0 | 0 | 0.72 | |
| | 7 | 660 | 600 | 42 | 0 | 0 | 0.69 | |
| | 8 | 660 | 600 | 40 | 0 | 0 | 0.67 | |
| | 9 | 670 | 610 | 48 | 0 | 0 | 0.67 | |
| | 10 | 660 | 600 | 42 | 0 | 0 | 0.65 | |
| | 11 | 660 | 600 | 48 | 0 | 0 | 0.64 | |
| | 12 | 660 | 600 | 48 | 0 | 0 | 0.70 | |
| | 13 | 660 | 600 | 46 | 0 | 0 | 0.66 | |
| | 14 | 660 | 600 | 48 | 0 | 0 | 0.64 | |
| | 15 | 650 | 590 | 49 | 0 | 0 | 0.71 | |
| | 16 | 660 | 600 | 44 | 0 | 0 | 0.66 | |
| | 17 | 650 | 590 | 49 | 0 | 0 | 0.73 | |
| | 18 | 650 | 590 | 49 | 0 | 0 | 0.70 | |

※ [I {200} + I {311}] ／I {220}
(1)溶体化温度：700℃　(2)中間加工率：50%　(3)仕上げ加工率：20%

[0015]

[Table 3]

| | No. | 引張強さ (N/mm²) | 耐力 (N/mm²) | 導電率 (%ISCA) | W曲げ性(R/t) G.W. | W曲げ性(R/t) B.W. | 結晶方位指数 ※ | 備考 |
|---|---|---|---|---|---|---|---|---|
| 比較例 | 19 | 450 * | 400 * | 55 | 0 | 0 | 1.03 | |
| | 20 | — | — | — | — | — | — | (1) * |
| | 21 | 640 | 580 | 31 * | 0 | 0 | 0.68 | (2) * |
| | 22 | — | — | — | — | — | — | (1) * |
| | 23 | — | — | — | — | — | — | (1) * |
| | 24 | 670 | 610 | 35 * | 2.0 * | 2.0 * | 0.55 | (3) * |
| | 3-5 | 590 | 530 | 53 | 2.0 * | 2.0 * | 0.38 * | (4) |
| | 3-6 | 610 | 550 | 51 | 2.0 * | 2.0 * | 0.44 * | (5) |
| | 3-7 | 700 | 680 | 49 | 2.5 * | 2.5 * | 0.25 * | (6) |

※ [I{200}+I{311}]／I{220}
(1)熱間圧延大割れ (2)耐応力腐食割れ性低い (3)熱間圧延微小割れ
(4)溶体化温度：650℃ (5)中間加工率：60% (6)仕上げ加工率：50%
*特性の劣る箇所

[0016] Any property of No.1-18 of the example of this invention shown in Table 2 is good. Among these, No.1 and No.2 have nickel and lower Si and intensity is a little low. On the contrary, for a certain reason, nickel and Si raise as No.4 and it comes out, and intensity is a little high, a crystal orientation index is lower and bending nature is a little low. Moreover, No.3-2, 3-3, and 3-4 have a lower crystal orientation index, and bending nature is a little low. On the other hand, for No.19 of the example of comparison shown in Table 3, nickel and Si are low and intensity is a low. On the contrary, since example No.of comparison 20 had nickel and high Si, the crack generated them with hot rolling. For example No.of comparison 21, since there is much Zn, conductivity is low, and stress-corrosion-cracking-proof nature is a low. Example No.of comparison 22 and No.23 had Sn or high P content, and the crack generated them with hot rolling. Bending nature is low, while No.24 have high Fe content and a microfissure occurs with hot rolling. No.3-5, 3-6, and 3-7 have a low crystal orientation index, and bending nature is low.

[0017]

[Effect of the Invention] According to this invention, the copper alloy board for electronic parts, such as a leadframe and a terminal with the outstanding bending nature, a connector, a switch, and a relay, can be obtained, maintaining high intensity.

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[Translation done.]

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the copper alloy board excellent in suitable bending nature to use for electronic parts, such as a copper alloy board especially a leadframe, a terminal, a connector, a switch, and a relay.

[Translation done.]

## PRIOR ART

[Description of the Prior Art] Various copper and the copper alloy are used for various electronic parts. In recent years, the flow of small-and-light-izing of electronic parts is progressing quickly. In connection with it, the outstanding bending nature which is equal to adhesion bending or 90-degree bending after notching is being required more often not to mention high intensity and high conductivity by the copper alloy board used for a leadframe, a terminal, a connector, a switch, a relay, etc. The Cu-nickel-Si system alloy is widely used for these uses especially as an alloy which has high intensity, high thermal resistance, a stress relaxation characteristic-proof [ high ], and comparatively high conductivity. However, coexistence of high intensity and bending nature was difficult for the present condition.

[Translation done.]

## EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, the copper alloy board for electronic parts, such as a leadframe and a terminal with the outstanding bending nature, a connector, a switch, and a relay, can be obtained, maintaining high intensity.

[Translation done.]

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] Conventionally, the elongation in a tension test has been used as the standard as an index of bending nature. Depending for the value of the elongation to the rate of cold working after annealing strongly is known. That is, in order to raise bending nature, it was a stock-in-trade that intensity reduces the rate of cold working low on the assumption that a bird clapper. That is, it was difficult to have made high intensity and the outstanding bending nature combine. this invention was made in view of the above-mentioned technical problem of the conventional material, and aims at obtaining a copper alloy board with the bending nature which was excellent while holding the high intensity of an Cu-nickel-Si system alloy.

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[Translation done.]

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MEANS

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[Means for Solving the Problem] In order to solve the aforementioned technical problem, as a result of inquiring wholeheartedly about an Cu-nickel-Si system alloy board, by controlling the degree of integration of crystal orientation, this invention person finds out that bending nature can be improved, and came to make this invention. Namely, the copper alloy board concerning this invention contains Si:0.1 - 1wt% nickel:0.4 - 5wt%. When it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [ the X diffraction intensity from the {200} sides in a board front face ] to I {220} for the X diffraction intensity from I {200} and {311} sides, it is characterized by filling the following formula.
[I{200}+I{311}]/I{220} >=0.5. [0005] In addition, the above-mentioned copper alloy board can contain Sn:0.01 - 5wt% either or both sides Zn:0.01 - 10wt%. The above-mentioned copper alloy board Furthermore, B, C, P, S, calcium, V, Ga, germanium, Each element [ of Nb, Mo, Hf, Ta, Bi, and Pb ] 0.0001 - 0.1wt% (when two or more sorts add, it is less than [ 0.1wt% ] in total), one sort or two sorts or more of elements chosen from from while of each element [ of Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, and Au ] 0.001 - 1wt% -- the sum total -- less than [ 1wt% ] -- it can contain
[0006]
[Embodiments of the Invention] Next, the reasons for limitation of the component of the copper alloy concerning this invention, crystal orientation, etc. are explained.
(nickel and Si) These components are effective in raising intensity by forming the intermetallic compound of nickel and Si in the state where it lived together, without reducing conductivity sharply. If less than [ 0.4wt% ] or/, and Si do not have [ nickel ] the effect less than [ 0.1wt% ], and nickel exceeds 5wt(s)% or/and Si exceed 1wt%, hot-working nature will fall remarkably. Therefore, both components are made into Si:0.1 - 1wt% nickel:0.4 - 5wt%.
[0007] (Zn) Although Zn has the operation which raises solder heatproof detachability and migration-proof nature, less than [ 0.01wt% ] is not enough as the effect. If 10wt(s)% is exceeded, while not only conductivity falls, but soldering nature will fall, stress corrosion crack sensitivity-proof becomes high and is not desirable, either. Therefore, Zn may be 0.01 - 10wt%.
(Sn) Sn is a component which raises intensity by solid solution strengthening. 0. If the effect exceeds 5wt% rather than is enough, while the effect will be saturated with less than [ 01wt% ], between heat and cold-working nature deteriorate. Therefore, Sn may be 0.01 - 5wt%.
[0008] (Accessory constituent) Each element of B, C, P, S, calcium, V, Ga, germanium, Nb, Mo, Hf, Ta, Bi, and Pb has the role which raises press blanking nature. Less than [ 0.0001wt% ], the effect does not exist, and if 0.1wt% is exceeded, while hot-working nature will deteriorate, as for these elements, bending nature also deteriorates. Moreover, each element of Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, and Au has the role which raises press blanking nature, and, in addition, raises intensity further by coexistence with an nickel-Si compound. Less than [ 0.001wt% ], the effect does not exist, and if 1wt% is exceeded, while between heat and cold-working nature will deteriorate, as for these elements, bending nature also deteriorates. Therefore, about above-mentioned Be-Au, it considers [ B-Pb / above-mentioned ] as each element 0.001 - 1wt% each element 0.0001 - 0.1wt% (in the case / Two or more sorts add. / the sum total 0.1wt(s)% less than), and it is both the sum total and may be less than / 1wt% /.
[0009] (Crystal orientation) {200} on the front face of a board and the accumulation rate of {311} sides increase, and if the copper alloy board containing nickel and Si is rolled out, its accumulation rate of {220} sides will increase, as it recrystallizes and the particle size becomes large. Although the copper alloy board concerning this invention is finished further hot rolling, cold rolling, solution treatment, cold rolling, deposit annealing, and if needed, and it is distorted and it is manufactured at cold rolling and the process of annealing, it can control this accumulation rate by adjusting the cold rolling process (working ratio) of solution treatment (solution-ized

temperature, time) and after that in this manufacturing process. The accumulating-totals working ratio after the temperature to which solution treatment temperature specifically exceeds 710 degrees C, and solution treatment is the conditions that less than 50% is desirable. In addition, it deposit-anneals, or is distorted, and after that takes this accumulation rate, and it does not change a lot depending on annealing. Moreover, the content of nickel and Si also influences an accumulation rate. In this invention, these accumulation rates have bending nature and strong correlation, and the range of a proper accumulation rate is searched for as shown in the aforementioned formula based on knowledge that bending nature is controllable by controlling these accumulation rates on the front face of a board. In addition, if this value becomes not much large also with regards to the intensity of a board as for the value of [I{200}+I{311}]/I {220}, since the intensity of a board will fall, as for this value, 1.0 or less are desirable.

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[Translation done.]

## EXAMPLE

[Example] Next, the example of this invention is explained below with the example of comparison. The air dissolution was carried out under charcoal covering in the kryptol furnace, the copper alloy of the chemical composition shown in Table 1 was cast to the book mold, and the 50x80x200mm ingot was produced. This ingot was heated at 930 degrees C, and after hot rolling, water quenching was carried out immediately and it considered as hot-rolling material with a thickness of 15mm. In order to remove the scale of the front face of this hot-rolling material, the front face was cut by the grinder. After cold-rolling this, solution treatment for 20 seconds and 30% of cold rolling were performed at 750 degrees C, it adjusted to 0.25mm of board thickness, deposit annealing of 2 hours was given at 480 degrees C, and the examination was presented.
[0011]
[Table 1]

| | | Cu | Ni | Si | Zn | Sn | 副成分 |
|---|---|---|---|---|---|---|---|
| 発明例 | 1 | 残部 | 0.5 | 0.1 | – | – | |
| | 2 | 残部 | 1.0 | 0.2 | – | – | |
| | 3 | 残部 | 1.8 | 0.4 | – | – | |
| | 4 | 残部 | 3.2 | 0.7 | – | – | |
| | 5 | 残部 | 4.6 | 1.0 | – | – | |
| | 6 | 残部 | 1.8 | 0.4 | 1.1 | – | |
| | 7 | 残部 | 1.8 | 0.4 | – | 0.5 | |
| | 8 | 残部 | 1.8 | 0.4 | 1.1 | 0.5 | |
| | 9 | 残部 | 1.8 | 0.4 | – | – | B:0.01, C:0.001, Be:0.02 |
| | 10 | 残部 | 1.8 | 0.4 | – | – | P:0.005, Mg:0.04, Al:0.1 |
| | 11 | 残部 | 1.8 | 0.4 | – | – | S:0.005, Ca:0.001, Ti:0.05 |
| | 12 | 残部 | 1.8 | 0.4 | – | – | V:0.001, Cr:0.2, Mn:0.04 |
| | 13 | 残部 | 1.8 | 0.4 | – | – | Ga:0.03, Ge:0.02, Fe:0.06 |
| | 14 | 残部 | 1.8 | 0.4 | – | – | Nb:0.01, Co:0.1, Zr:0.07 |
| | 15 | 残部 | 1.8 | 0.4 | – | – | Mo:0.003, Hf:0.008, Ag:0.1 |
| | 16 | 残部 | 1.8 | 0.4 | – | – | Ta:0.004, Cd:0.1, In:0.2 |
| | 17 | 残部 | 1.8 | 0.4 | – | – | Bi:0.0009, Pb:0.008 Sb:0.005 |
| | 18 | 残部 | 1.8 | 0.4 | – | – | Te:0.01, Au:0.07 |
| 比較例 | 19 | 残部 | 0.3 * | 0.07* | – | – | |
| | 20 | 残部 | 5.2 * | 1.2 * | – | – | |
| | 21 | 残部 | 1.8 | 0.4 | 12 * | – | |
| | 22 | 残部 | 1.8 | 0.4 | – | 5.8 * | |
| | 23 | 残部 | 1.8 | 0.4 | – | – | P:0.2* , Mn:0.02 |
| | 24 | 残部 | 1.8 | 0.4 | – | – | Ca:0.002, Fe:1.6* |

*本発明の規定範囲から外れる箇所

[0012] Moreover, in order to obtain the copper alloy board of various crystal orientation accumulation rates in addition to the above-mentioned process, about the alloy of composition of No.3, solution treatment temperature was manufactured to 750-degree C others on conditions (650 degrees C (No.3-5) and 700 degrees C (No.3-2)). Moreover, the rate of cold working after solution treatment was also manufactured to everything but 30% on 50% (No.3-3) and 60% (No.3-6) of conditions. Furthermore, the rate of finishing cold working after deposit annealing was also manufactured to everything [ above ] but 0% on 20% (No.3-4) and 50% (No.3-7) of conditions. About the material (No.3-4, No.3-7) which performed finish cold working after deposit annealing, it annealed by distorting 20 seconds at 450 degrees C. Any conditions adjusted the last board thickness to 0.25mm.
[0013] About these test specimens, tensile strength, proof stress, conductivity, W-bending processability, and crystal orientation were investigated in the following way. The result is shown in Table 2 and 3.
<Tensile strength, proof stress> JIS Z It applied to the method given in 2241 correspondingly. In addition, proof stress adopted 0.2% of permanent sets by the offset method. A test piece is JIS. Z The No. 5 test piece of 2201 was used.
<Conductivity> JIS H It applied to the method given in 0505 correspondingly. Measurement of electric resistance used the double bridge.
<W-bending> JIS H It applied to the method given in 3110 correspondingly. Test piece width of face was set to 10mm, and it bent, having applied the load of 1,000kgf. the ratio of minimum bend-radius R which makes the test piece extraction direction G.W. (a bending shaft is right-angled to a rolling direction), and B.W. (a bending shaft is parallel to a rolling direction), and a crack does not generate, and the test-specimen board thickness t -- R/t estimated

The copper alloy board front face of a <crystal orientation> final-product state (0.25mm thickness) was made to carry out incidence of the X-ray, and the intensity from each diffraction side was measured. Although the measurement depth from a front face changes with incident angles, the crystal orientation data in about 20-30-micrometer Fukashi are obtained at the maximum. Bending nature and correlation compared the rate of the diffraction intensity of {200}, {311}, and {220} sides from the inside, and it asked for the crystal orientation index ([I{200}+I {311}] /I {220}). [ strong ] In addition, the conditions of X-ray irradiation are kind:Cu of an X-ray. K-alpha 1, tube-voltage:40kV, the tube electric current: It was 200mA, and it measured, making a sample rotate within a flat surface.

[0014]

[Table 2]

| | No. | 引張強さ (N/mm²) | 耐力 (N/mm²) | 導電率 (%ISCA) | W曲げ性(R/t) G.W. | W曲げ性(R/t) B.W | 結晶方位指数 ※ | 備考 |
|---|---|---|---|---|---|---|---|---|
| 発明例 | 1 | 500 | 450 | 53 | 0 | 0 | 0.93 | |
| | 2 | 550 | 500 | 52 | 0 | 0 | 0.86 | |
| | 3-1 | 640 | 580 | 50 | 0 | 0 | 0.75 | |
| | 3-2 | 610 | 550 | 51 | 0.5 | 0.5 | 0.59 | (1) |
| | 3-3 | 630 | 570 | 51 | 0.5 | 0.5 | 0.61 | (2) |
| | 3-4 | 660 | 630 | 49 | 1.0 | 1.0 | 0.54 | (3) |
| | 4 | 700 | 640 | 48 | 0.5 | 0.5 | 0.57 | |
| | 5 | 730 | 670 | 46 | 1.0 | 1.0 | 0.51 | |
| | 6 | 640 | 580 | 50 | 0 | 0 | 0.72 | |
| | 7 | 660 | 600 | 42 | 0 | 0 | 0.69 | |
| | 8 | 660 | 600 | 40 | 0 | 0 | 0.67 | |
| | 9 | 670 | 610 | 48 | 0 | 0 | 0.67 | |
| | 10 | 660 | 600 | 42 | 0 | 0 | 0.65 | |
| | 11 | 660 | 600 | 48 | 0 | 0 | 0.64 | |
| | 12 | 660 | 600 | 48 | 0 | 0 | 0.70 | |
| | 13 | 660 | 600 | 46 | 0 | 0 | 0.66 | |
| | 14 | 660 | 600 | 48 | 0 | 0 | 0.64 | |
| | 15 | 650 | 590 | 49 | 0 | 0 | 0.71 | |
| | 16 | 660 | 600 | 44 | 0 | 0 | 0.66 | |
| | 17 | 650 | 590 | 49 | 0 | 0 | 0.73 | |
| | 18 | 650 | 590 | 49 | 0 | 0 | 0.70 | |

※ [I{200}+I{311}] ／I{220}
(1)溶体化温度：700℃　(2)中間加工率：50%　(3)仕上げ加工率：20%

[0015]

[Table 3]

| | No. | 引張強さ (N/mm²) | 耐力 (N/mm²) | 導電率 (%ISCA) | W曲げ性(R/t) G.W. | W曲げ性(R/t) B.W. | 結晶方位指数 ※ | 備考 |
|---|---|---|---|---|---|---|---|---|
| 比較例 | 19 | 450 * | 400 * | 55 | 0 | 0 | 1.03 | |
| | 20 | — | — | — | — | — | — | (1) * |
| | 21 | 640 | 580 | 31 * | 0 | 0 | 0.68 | (2) * |
| | 22 | — | — | — | — | — | — | (1) * |
| | 23 | — | — | — | — | — | — | (1) * |
| | 24 | 670 | 610 | 35 * | 2.0 * | 2.0 * | 0.55 | (3) * |
| | 3-5 | 590 | 530 | 53 | 2.0 * | 2.0 * | 0.38 * | (4) |
| | 3-6 | 610 | 550 | 51 | 2.0 * | 2.0 * | 0.44 * | (5) |
| | 3-7 | 700 | 680 | 49 | 2.5 * | 2.5 * | 0.25 * | (6) |

※ [I{200} + I{311}] ／ I{220}
(1)熱間圧延大割れ (2)耐応力腐食割れ性低い (3)熱間圧延微小割れ
(4)溶体化温度：650℃ (5)中間加工率：60% (6)仕上げ加工率：50%
*特性の劣る箇所

[0016] Any property of No.1-18 of the example of this invention shown in Table 2 is good. Among these, No.1 and No.2 have nickel and lower Si and intensity is a little low. On the contrary, for a certain reason, nickel and Si raise 5 as No.4 and it comes out, and intensity is a little high, a crystal orientation index is lower and bending nature is a little low. Moreover, No.3-2, 3-3, and 3-4 have a lower crystal orientation index, and bending nature is a little low. On the other hand, for No.19 of the example of comparison shown in Table 3, nickel and Si are low and intensity is a low. On the contrary, since example No.of comparison 20 had nickel and high Si, the crack generated them with hot rolling. For example No.of comparison 21, since there is much Zn, conductivity is low, and stress-corrosion-cracking-proof nature is a low. Example No.of comparison 22 and No.23 had Sn or high P content, and the crack generated them with hot rolling. Bending nature is low, while No.24 have high Fe content and a microfissure occurs with hot rolling. No.3-5, 3-6, and 3-7 have a low crystal orientation index, and bending nature is low.

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[Translation done.]